(12) UK Patent Application (19) GB (11) 2 153 708 A

(43) Application published 29 Aug 1985

(21) Application No 8403617

(22) Date of filing 10 Feb 1984

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(51) INT CL[4]
B05C 3/12 11/02 B29C 47/02

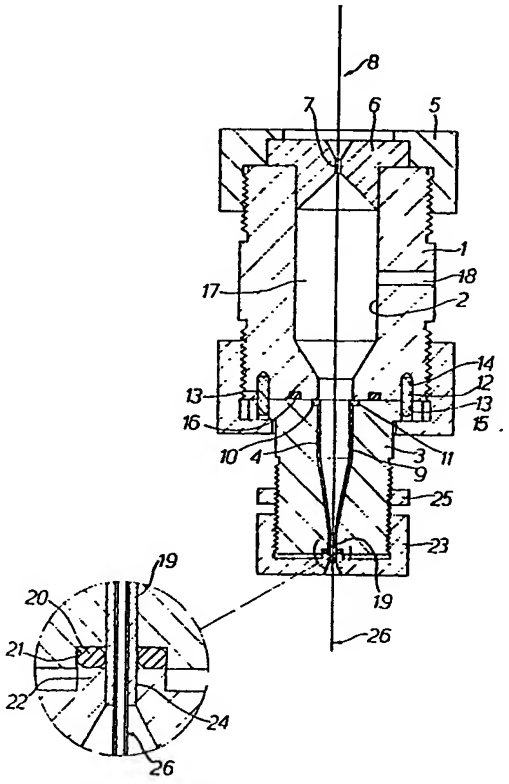
(52) Domestic classification
B2L 504 D
B5A 1G1 1G7A1 1G7B 1G7C 1R214E 1R314C12 1R314C1X 1R442 2C 2M T17A T17N U1S 1915 B2L B5A

(56) Documents cited
WO 8300451

(58) Field of search
B2L

(54) Coating applicator

(57) An applicator for coating optical fibres directly after drawing includes a chamber (17) for containing coating material and a flexible orifice element (19) through which the fibre (8) is pulled and which serves to ensure that there is a thin coating of the coating material on the fibre. The coating thickness can be varied during drawing by varying the compression of a compressible ring (21) and thus varying the internal diameter dimension of the orifice element (19). The coating thickness can thus be controlled, throughout the duration of a pull of an optical fibre preform into an optical fibre, by an automatic feedback process. Predetermined variations in coating thickness can also be achieved.



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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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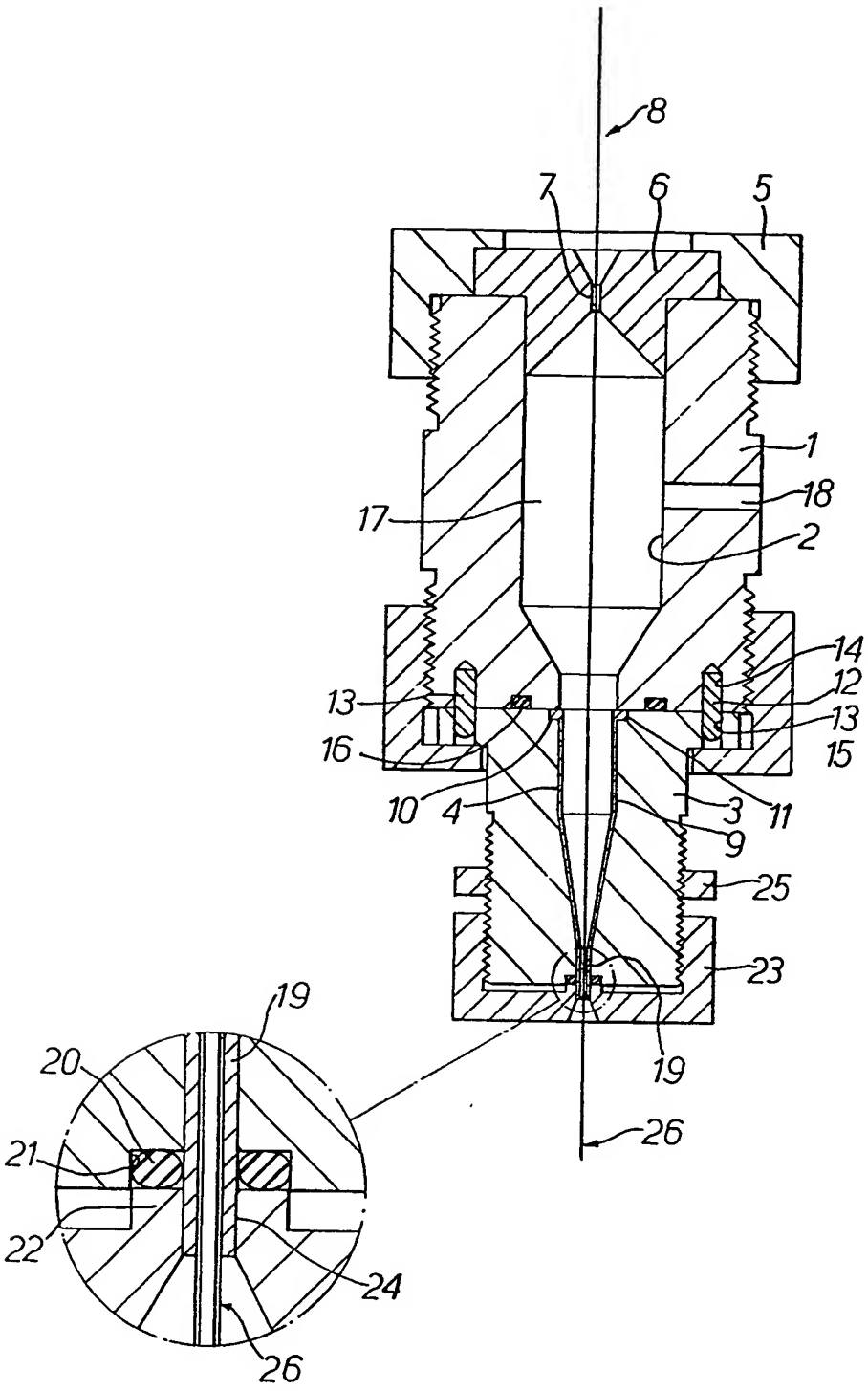

SPECIFICATION

Coating applicator

This invention relates to coating applicators and in particular, but not exclusively, to applicators for coating optical fibres.

During the production of optical fibre a protective coating is applied to the fibre at the earliest possible point after drawing, for example, from an optical fibre preform fed into a furnace. The protective coating is necessary since without it any contact of an uncoated optical fibre with a solid object may cause abrasion damage which significantly weakens the fibre. Typically this protective, or primary, coating comprises a polymer material which is either thermally or ulta-violet-light curable, for example Sylgard 182 or De Sato 008, respectively. Various optical fibre coating methods and apparatus have previously been proposed, however they have not proved entirely satisfactoy, and suffer from various disadvantages.

According to one aspect of the present invention there is provided a coating applicator including a chamber for containing a coating material, wherein in use of the applicator an elongate member to be coated is passed through the chamber and exits therefrom through an outlet, wherein the outlet is comprised by a flexible orifice element, whose internal dimensions are related to the thickness of coating material applied to the member, and including means whereby the internal dimensions of the flexible orifice element may be varied in a controlled manner during passage of the member therethrough.

According to another aspect of the present invention there is provided a method of coating an elongate member comprising the steps of directing the member into a chamber containing a coating material, causing the member to exit the chamber via a flexible orifice element, the internal dimensions of the flexible orifice element being related to the thickness of coating material applied to the member, and adjusting the internal dimensions of the flexible orifice element whilst the elongate member is passing therethrough.

According to another aspect of the present invention there is provided a method of making an optical fibre comprising passing an optical fibre through a coating applicator for coating the optical fibre and controlling the size of a flexible orifice member surrounding the fibre whereby to control the thickness of the coating as coating proceeds.

Embodiments of the present invention will now be described with reference to the accompanying drawing, which is in section and somewhat schematic, of a coating applicator with an optical fibre extending therethrough, a portion of the applicator is also shown on an enlarged scale in order to facilitate understanding of the operation thereof.

The coating applicator shown in the drawing comprises a main body portion 1, having a bore 2 extending therethrough, an auxiliary body portion 3, having a bore 4 extending therethrough, an internally-threaded ring 5 which is screwed onto the uppermost, in use, end of the main body portion 1 which is correspondingly externally-threaded and a top, in use, seal 6 which includes a central bore 7 through which an optical fibre 8 may be passed. The auxiliary body portion 3 provides a housing for a thin walled flexible applicator 9 which includes an annular shoulder 10 that is disposed in an annular locating groove 11 therefor in the body portion 3. The auxiliary body portion 3 is screwed to the main body portion 1, with their bores 2 and 4 in alignment, by means of an internally-threaded bored cap or nut 12. Pins 13, in corresponding bores 14 and 15 of the body portion 1 and body portion 3, are employed to ensure alignment and a seal 16 is disposed between the two portions 1 and 3. A coating chamber 17 is, in the assembled state of the various applicator elements, defined within the main body portion. Coating material under pressure may be supplied to the coating chamber 17 via a duct 18.

The flexible applicator 9 includes a substantially cylindrical outlet portion 19 which projects from the auxiliary body portion. A compressible "O" ring 20 is disposed in an annular groove 21 of the auxiliary body portion and surrounds the cylindrical outlet portion 19 of the flexible applicator 9 at a position between its ends. The "O" ring 20 is maintained in the groove 21 by a corresponding annular land 22 of a nut 23. The nut 23 includes a bore 24 into which the outlet portion 19 of the applicator projects. The nut 23 is internally threaded and screwed onto a correspondingly-externally-threaded portion of the auxiliary body portion 3. A lock nut 25 is provided in order, if required, to maintain the nut 23 in any position to which it is adjusted as will be described hereinafter.

The flexible applicator 9, which is comprised of a soft compliant plastics material, may be made of any suitable material which is not adversely affected by the coating material, for example silicone rubber. The bore presented to an optical fibre 8 passed through the flexible applicator 9 generally tapers in the direction towards the outlet portion 19. In view of coating material flow considerations under certain operating conditions the fibre will tend to self-centre with respect to the outlet portion 19 so that the coating is concentric with regard to the fibre. However, alternative techniques can be employed to ensure concentricity. The top seal 6 may be made of Teflon, and is secured in position by, for example, a shoulder of ring 5, as illustrated or an internally threaded mounting plate which takes the place of ring 5 and has a seal-retaining lip, and bores for use in bolting the assembly to another member. The use of a soft flexible applicator means that the possibility of abrasion damage as caused by a conventional metallic die is reduced.

The applicator shown in the drawing is employed as follows. An optical fibre preform is fed into a furnace (not shown) disposed vertically above the applicator, the bores 2 and 4 of which are disposed vertically. Optical fibre 8 is drawn from the preform. At the start of a "pull" fibre is drawn from the tip of the preform and fed into the

coating chamber 17. At this time the applicator is dry, that is there is no coating material in the chamber 17. The fibre is passed through the flexible applicator and wound onto winding apparatus (not shown) disposed below the applicator. The pull then begins, the winding apparatus serving the pull the fibre as well as wind it up onto a reel. Coating material is then introduced under pressure into the coating chamber 17 via the duct 18 and the fibre emerging from the outlet end of the applicator is a coated fibre 26. Prior to winding on the reel the coating material is cured by, for example, heat or ultra-violet light as appropriate to the material employed. Alternatively the coating material may be supplied unpressurised to the chamber and pressurised by separate means applied to the chamber.

The thickness of the coating on the fibre 26 is determined by the internal diameter of the cylindrical outlet portion 19 of the flexible applicator. In dependence on the degree to which the nut 23 is screwed onto the auxiliary body portion 3 the force applied to the compressible "O" ring 20 is variable. The greater the force, the more compressed the "O" ring 20 and correspondingly the smaller the internal diameter of the cylindrical outlet portion 19 in the vicinity of the ring 20, and thus the thinner the coating applied to the optical fibre. Thus the coating thickness may be varied merely by adjusting the rotational position of the nut 23 to vary the compression applied to the "O" ring 20. With conventional fixed orifice dies it is not possible to vary the coating thickness during a pull, whereas this is achievable with the applicator described above.

The variable thickness coating applicator can be employed in various ways. Firstly, automatic feedback control of coating thickness is made possible. In this case the fibre diameter may be measured after drawing and prior to passage through the applicator and the coating thickness controlled in dependence on the measurement of fibre diameter in order to provide an overall uniform diameter coated fibre. The measured diameter being employed in a control circuit of a drive means (not shown) for automatically adjusting the nut 23 and compression of the "O" ring 20 to produce the required internal diameter for portion 19. Secondly, the thickness of the coating on a fibre may be varied in any desired manner by correspondingly adjusting the nut 23 and the compression on the "O" ring 20. In particular the coating thickness may be varied in a cyclic manner, which is of use in, for example, optical fibre sensor applications and for splicing purposes. Thirdly, a uniform thickness of coating on a variable thickness, for example, slowly tapering, optical fibre may be achieved by means of feedback from a coated fibre diameter measuring instrument, in conjunction with the bare fibre measuring instrument if the coated fibre measuring instrument is alone unable to determine the coating thickness. The coating applicator may, for example, be employed to provide a coating of variable or substantially constant thickness of the order of 10-500 micron on a constant (less than 1% variation) optical fibre of 125 micron outside diameter.

Whereas the means of adjusting the internal diameter of the cylindrical outlet portion 19 of the flexible applicator has been described as a compressible "O" ring and means for adjusting the compression thereof, alternative means can be envisaged, for example an iris whose aperture size can be adjusted in a controlled manner, althought care will be needed to ensure that the leaves of the iris do not cut into the flexible applicator, or another form of controllably movable ring.

Whilst the invention has been described in terms applying coatings to optical fibres it is alternatively applicable to the coating of other elongate members where the ability to vary the coating thickness is required.

CLAIMS

1. A coating applicator including a chamber for containing a coating material, wherein in use of the applicator an elongate member to be coated is passed through the chamber and exits therefrom through an outlet, wherein the outlet is comprised by a flexible orifice element, whose internal dimensions are related to the thickness of coating material applied to the member, and including means whereby the internal dimensions of the flexible orifice element may be varied in a controlled manner during passage of the member therethrough.

2. An applicator as claimed in claim 1, wherein said means include a compressible ring through which the flexible orifice element extends, which ring is disposed such as to influence the internal dimensions of the flexible orifice element in dependence on the state of compression of the ring.

3. An applicator as claimed in claim 2, wherein the ring is disposed in a groove of a housing member and retained therein by a nut threadably engaged with the housing member, and wherein the state of compression of the ring is variable by rotation of the nut.

4. An applicator as claimed in claim 1, wherein said means include an adjustable iris through which the flexible orifice element extends, which iris is disposed such as to influence the internal dimensions of the flexible orifice element in dependence on the size of the iris aperture.

5. An applicator as claimed in any one of claims 2 to 4 and for use in coating an optical fibre, wherein there is an inlet to the chamber for the optical fibre, which inlet is in alignment with the outlet, and wherein there is an inlet duct whereby coating material can be supplied to the chamber during use of the applicator.

6. A coating applicator substantially as herein described with reference to and as illustrated in the accompanying drawing.

7. A method of coating an elongate member comprising the steps of directing the member into a chamber containing a coating material, causing the member to exit the chamber via a flexible orifice element, the internal dimensions of the flexible orifice element being related to the thickness of

coating material applied to the member, and adjusting the internal dimensions of the flexible orifice element whilst the elongate member is passing therethrough.

8. A method as claimed in claim 7, wherein the flexible orifice element extends through a compressible ring, which ring is disposed such as to influence the internal dimensions of the flexible orifice element in dependence on the state of compression of the ring, and wherein said adjusting step comprises adjusting the compression of the ring.

9. A method as claimed in claim 8, wherein the ring is disposed in a groove of a housing member and retained therein by a nut threadably engaged with the housing member, and wherein adjustment of the compression of the ring is achieved by rotation of the nut.

10. A method as claimed in claim 7, wherein the flexible orifice element extends through an adjustable iris, which iris is disposed such as to influence the internal dimensions of the flexible orifice element in dependence on the size of the iris aperture, and wherein said adjusting step comprises adjusting the size of the iris aperture.

11. A method as claimed in any one of claims 8 to 10, wherein the elongate member is an optical fibre and the coating is applied in-line with the fibre drawing process, wherein the thickness of the uncoated fibre is monitored and employed to adjust the internal dimensions of the flexible orifice element automatically to obtain a coated fibre with an overall uniform diameter.

12. A method as claimed in any one of claims 8 to 10, wherein the elongate member is an optical fibre and the coating is applied in-line with the fibre drawing process, and wherein the internal dimensions of the flexible orifice element are varied in a predetermined manner whereby to vary the thickness of the coating in a corresponding predetermined manner.

13. A method as claimed in any one of claims 8 to 10, wherein the elongate member is an optical fibre and the coating is applied in-line with the fibre drawing process, wherein the thickness of the applied coating is monitored and employed to adjust the internal dimensions of the flexible orifice element automatically whereby the coating thickness is maintained substantially constant.

14. A method of making an optical fibre comprising passing an optical fibre through a coating applicator for coating the optical fibre and controlling the size of a flexible orifice member surrounding the fibre whereby to control the thickness of the coating as coating proceeds.

15. A method of coating optical fibres substantially as herein described with reference to the accompanying drawings.

Printed in the UK for HMSO, D8818935, 7/85, 7102.
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